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Mortality Among Hutch-Raised Domestic Rabbits

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INTRODUCTION

When domestic rabbits are raised in large numbers mortality becomes an important factor. The commercial grower may sustain a large financial loss. The investigator, using the animals for obtaining data, also sustains losses, which may be incalculable.

There is little in the literature that the grower or investigator can use as a standard with which to compare the mortality he is experiencing. Since 1930, cost-account studies on rabbit production have been conducted in Los Angeles County, Calif., by the Agricultural Extension Service of the University of California at Berkeley, and 16 annual reports have been issued. For the 10-year period of 1930-39 (9),² the cooperating breeders sustained average annual losses of 23 percent of the unweaned young and 19.1 percent of the mature stock. However, the reports gave no details on the causes of death or the approximate age at death.

During a part of the period since 1930, reports similar to those for Los Angeles County were issued for Riverside and San Bernardino Counties, and since World War II several additional southern counties in California have adopted the practice of making such studies (7, 8, 10). In this area, for 1947-49, inclusive, reports on cost studies gave an average mortality of 21.5 percent of unweaned young. The annual mortality for all mature stock was not reported, but for does alone the average was 35 percent. If bucks had been included, the percentage undoubtedly would have been somewhat lower; but a substantial difference would still remain between that figure and the 19.1 percent for the 1930-39 period.

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²Numbers in parentheses refer to Literature Cited, p. 14.

Some of the annual reports of the Los Angeles County Live Stock Department, notably those for 1939-40 to 1942-43, inclusive, have given summaries of the findings among rabbits autopsied (2, p. 47; 3, pp. 57-59; 4, pp. 49-51; 5, pp. 40-42). During this 4-year period, 1,224 animals from rabbitries in the field were autopsied, and the frequencies of appearance of more than 20 disorders, including combinations, were tabulated. The results from the studies are not representative, however, because the numbers of cases reported are not in proportion to their actual frequency. Animals of low value, such as nest-box babies, are not reported as often as animals of greater value; and well-recognized disorders, which are often the more common ones, are reported relatively less frequently than obscure or rare disorders.

Blount (1) published a brief summary of the "information obtained from an analysis of nearly 2,000 dead rabbits, during the year 1942." Leading all other diseases in his list is coccidiosis, which was associated with 36.7 percent of the cases. Blount explains, however, that animals affected with coccidiosis were placed in that category even though other diseases were also present. He adds, in another paragraph, the statement, "One rabbit in three died from it." This would indicate that he attributed death to coccidiosis if the animal showed evidence of the causative parasite, a conclusion that not everyone would accept.

The present study was undertaken at the United States Rabbit Experiment Station, Fontana, Calif., to provide a tentative standard for growers and investigators in comparing their death losses. The word "tentative" is used because mortality is subject to fluctuations of many sorts and for many reasons. The averages of a decade ago are inapplicable now, in many respects. Some disorders actually appear to be increasing, but some have shown significant declines.

MATERIALS AND METHODS

The data given in this circular were obtained on the entire herd of rabbits maintained at the United States Rabbit Experiment Station from 1947 to 1949, inclusive. Commercial rabbitries in this vicinity have been studied from time to time to determine to what extent losses in the station herd are comparable with those of other herds, and the information obtained is also presented.

The animals in the station herd have been maintained under somewhat varying conditions, depending on the requirements of the experiments in which they were used. Rations, for example, have been of many types, as have other feeding practices, as well as management. These variations, however, simulate those employed in the field. In fact, variations in practice among commercial growers are greater than those represented in this report.

Mortality data include the losses of animals through natural causes or by injury or death resulting from faulty equipment or practices. Animals killed for study, unless they were already sick or not potentially marketable, are excluded. No appreciable error is introduced by this method because no experiment during the 3-year period required the destruction of animals less than 56 days of age. In reporting the data, as shown in table 1, the animals were divided into 3

groups: Unweaned young; developing animals, those from 57 to 180 days of age; and mature rabbits. These data covered the 10 disorders most frequently associated with mortality and also the most frequent associations of 2 and 3 disorders.

In the unweaned stock, the records included all losses among young retained, including babies transferred to foster mothers, but not the young destroyed at birth for want of mothers. In most instances as many as eight animals per litter were retained; but in an experiment begun in 1945 and not yet completed when this study opened, litters consisted of a maximum of seven animals. Weaning age of 56 days was essentially uniform, no animals having been weaned earlier except when the does died. In only a few instances did the young occupy the same hutch as the does after 56 days.

A large proportion of developing animals ordinarily are consigned to the meat pen, although at the station many were used in various studies that did not require their being reared to maturity. Those placed in the meat pen were kept there for 1 to 14 days, but less than a week on the average. Animals of 56 to 180 days of age retained for breeding stock are included in the developing-rabbits group in table 1, but are segregated and used exclusively for the determination of the weekly death rates shown in figure 1 and in calculating the incidence of coccidiosis shown in figure 2.

Mature animals were largely New Zealand Whites more than 180 days of age kept for breeding and rearing litters. A few Angora "woolers" and a small number of French Silver and Havana animals were also included. Few young were reared from these breeds, but inclusion of all breeds in all age groups has been followed consistently.

Each animal found dead or in a condition that made destruction humane and necessary was examined. Except for very young animals decomposed to such an extent that a study of internal organs would be meaningless, all animals were autopsied, and laboratory diagnosis was used for verification when doubt existed. Except during March 1949, all animals more than 21 days old and some younger ones were examined on the day of death for evidence of intestinal parasites. This was done by emulsifying a portion of the caecal or intestinal content in water and studying it at a magnification of $100\times$ or higher powers if necessary.

RESULTS

Table 1 shows the mortality, at different ages, from various causes for the 3-year period, during which the station herd contained an average of 225 mature animals. Of these, 201 were New Zealand Whites and 24 were of miscellaneous breeds. During the entire period they produced 2,083 litters, from which 13,915 young, or an average of 6.7 per litter, were retained. Almost all of these were New Zealand Whites. Of the 13,915 young retained, 2,726 were lost from all causes by the end of 56 days—an average mortality of 19.6 percent.

Of the 11,189 animals that were weaned, 569 were selected to be kept for breeding. Of these, 489 were New Zealand Whites; 442 were does and 47, bucks. The remaining 80 animals were largely Angoras and consisted of 33 does and 47 bucks. They comprised almost the entire production of the miscellaneous breeds, only ob-

TABLE 1.—*Number of rabbits, according to age, dying of various causes at the U. S. Rabbit Experiment Station, Fontana, Calif., during the 3-year period, 1947 to 1949, inclusive*

Cause of death	Unweaned rabbits at age of—								Develop- ing rabbits (57-180 days of age)	Mature rabbits	Total at all ages
	0-7 days	8-14 days	15-21 days	22-28 days	29-35 days	36-42 days	43-49 days	50-56 days			
Enteritis	1	10	16	19	94	249	307	230	145	7	1,078
Pneumonia	8	26	45	14	3	7	16	20	31	89	259
Impaction	0	0	0	0	1	0	0	0	1	0	2
Long teeth	0	0	0	0	0	0	2	1	2	1	6
Abscessed jaw	0	0	0	0	0	2	0	4	1	1	8
Abscessed navel	10	4	5	3	5	2	0	0	29	3	33
Other abscesses	0	0	0	2	4	3	3	6	6	3	27
Septicemia	0	5	4	1	0	1	0	1	12	7	19
Toxemia	0	0	0	0	0	0	0	0	0	5	5
Metritis	0	0	0	0	0	0	0	0	0	3	3
Enteritis and pneumonia	0	0	2	4	8	45	77	98	52	3	289
Enteritis and impaction	0	0	0	1	6	51	51	26	21	0	156
Enteritis and abscessed navel	0	0	0	1	0	1	2	1	1	0	6
Pneumonia and impaction	0	0	0	2	0	3	3	4	3	7	22
Pneumonia and long teeth	0	0	0	0	1	3	3	2	0	1	10
Pneumonia and metritis	0	0	0	0	0	0	0	0	0	3	3
Pneumonia and abscessed jaw	0	0	0	0	1	1	0	3	2	4	11
Pneumonia and septicemia	0	0	2	0	0	1	3	1	0	8	15
Pneumonia and peritonitis	0	0	0	0	0	1	0	0	1	1	3
Pneumonia and toxemia	0	0	0	0	0	0	0	0	0	8	8
Long teeth and abscessed jaw	0	0	1	0	0	5	9	10	17	0	42
Enteritis, pneumonia, and impaction	0	0	0	1	0	11	19	17	6	1	55
Enteritis, pneumonia, and long teeth	0	0	1	2	0	0	4	4	3	0	14
Enteritis, impaction, and long teeth	0	0	0	0	0	0	1	0	0	0	1

Pneumonia, impaction, and abscessed navel	0	0	1	0	0	0	1	0	0	0	2	0	0	2
Pneumonia, long teeth, and abscessed navel	0	0	0	0	0	1	0	0	0	0	1	0	0	1
Pneumonia, long teeth, and abscessed jaw	0	0	0	0	0	1	8	14	6	6	29	2	6	37
Starvation in very young animals	183	44	31	4	1	0	0	0	0	0	263	0	0	263
Miscellaneous ¹	463	208	88	23	5	10	6	6	1	17	804	11	11	832
Total	665	298	197	75	130	405	521	435	316	168	2,726	316	168	3,210
Percentage of total dead	20.7	9.3	6.1	2.3	4.1	12.6	16.2	13.6	9.9	5.2	84.9	9.9	5.2	100
Percentage of unweaned dead	24.4	10.9	7.2	2.8	4.8	14.8	19.1	16.0	0	0	100	0	0	0

¹ Of these, the following were too decomposed for autopsy findings: 270 at 0 to 7 days of age; 83 at 8 to 14 days; 33 at 15 to 21 days; 2 at 22 to 28 days; 1 at 36 to 42 days; and 2 at 43 to 48 days; a total of 391.

viously defective animals having been culled. During the 3-year period, 54, or 9.5 percent, of the 569 developing animals died. The remainder of the weaned animals—10,620—would have reached the meat pen under commercial practice. On the average, throughout the period under consideration, these animals were held 4 or 5 days in the meat pen, during which time 262, or 2.5 percent, were lost.

The average annual mortality of mature animals was 24.8 percent. Among the New Zealand Whites, for which the ratio of does to bucks averaged 5.3 to 1, losses averaged 15 to 1. Among the miscellaneous breeds, whose production was low and the doe-to-buck population was 1.4 to 1, losses were distributed about equally between the two sexes. Prompt culling in accordance with rigid standards of performance undoubtedly lowers the percentage of mortality in a herd but temporarily increases the total annual replacement. However, the necessity of keeping experimental lots as nearly intact as possible deferred culling the station herd.

Figure 1 shows the weekly death rate for animals of different ages from all causes combined, from enteritis alone, from enteritis and pneumonia combined, and from pneumonia alone. Three sources of mortality—enteritis, pneumonia, and nest-box mortality of certain types—were of such significance throughout this study as to warrant special consideration. Coccidiosis, although not appearing in table 1 and not found as a cause of mortality in a single instance in the entire 3 years, is also given special consideration because some investigators have regarded it as an important factor in mortality.

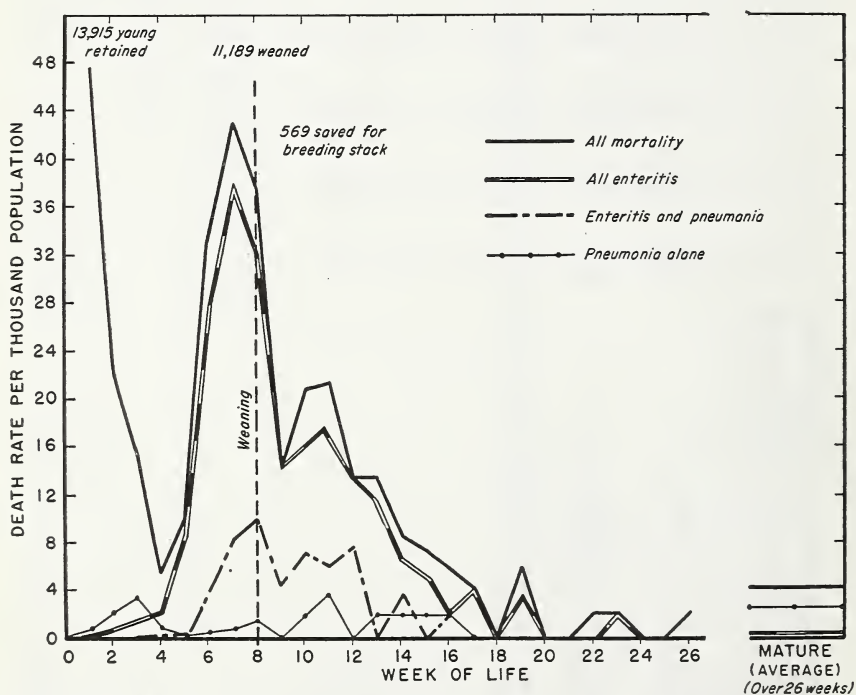


FIGURE 1.—Mortality rate each week from major causes at the United States Rabbit Experiment Station from 1947 to 1949, inclusive.

ENTERITIS

Of the 3,210 animals lost during the 3-year period, 1,599, or 49.8 percent, had enteritis in some form, manifested by an inflammation of the intestinal tract, often involving the caecum. In two-thirds of the cases enteritis was present alone; in the remainder it was associated with other disorders. Pneumonia was the most frequent complication, being present in 22.4 percent of all enteritis cases. However, the frequency of its appearance as a complication increased with age, as figure 1 shows. It was present in 26.3 percent of the developing animals and in 44.4 percent of the mature stock dying with enteritis. Impaction—any consolidation of the content of the caecum or large intestine that would interfere with the free movement of material—attended enteritis in 13 percent of all cases, but was slightly more prevalent in the younger animals. In the unweaned animals the percentage was 13.5; in the developing animals, 11.8; and in the mature animals, 9.1.

Enteritis cases fall more or less distinctly into three major groups, according to the predominating symptoms. Mucoid enteritis, in this circular, is restricted to those cases in which a gelatinous secretion filling the large intestine or voided from it is the predominating symptom. In diarrheal enteritis, the most conspicuous symptom is extreme fluidity of the bowel content or a profuse diarrhea, or both. In hemorrhagic enteritis, the intestinal tract, usually exclusive of the large intestine, is red throughout because of free blood in the walls of the intestine and the caecum. Rarely is blood found in the lumen of the intestine or caecum, and it is not, therefore, voided with the feces.

The frequency with which each type is encountered differs somewhat at different ages, and the relative prevalence of complications with pneumonia also differs. Because of these circumstances, enteritis cases were recorded by type, as shown in table 2. Diarrheal enteritis averaged about 82 percent of the total; mucoid enteritis, about 12 percent; and hemorrhagic enteritis, only 6 percent. Pneumonia appeared as a complicating factor with greatest relative frequency in the mucoid types and was present in only 1 case of the hemorrhagic type. Among the unweaned animals, for which cases were numerous enough to make records of age at death significant, the average age at death was lowest with the hemorrhagic type, highest with the mucoid type, and intermediate with the diarrheal type. Cases complicated with pneumonia averaged 2.5 days older at death, with very little difference among the three types.

PNEUMONIA

Pneumonia was present at death in 729, or 22.7 percent, of the 3,210 animals. However, only 18 percent of the unweaned young that died showed it, and 7 out of 10 of these had predisposing disorders of the intestinal tract—enteritis, impaction, or both. The relationship of mortality from pneumonia to that from enteritis and from all the diseases is shown in figure 1. Among the developing animals, 33 percent showed pneumonia at death, and again enteric disturbances were pres-

TABLE 2.—*Enteritis cases, classified according to type and to complication with pneumonia*

Autopsy finding	Unweaned animals (0-56 days old)			Developing animals (57-180 days old)		Mature animals	
	Number	Percent	Days ¹	Number	Percent	Number	Percent
Diarrheal enteritis, alone.....	871	64.1	43.6	129	59.4	5	55.5
Diarrheal enteritis and pneumonia....	250	18.4	46.1	47	21.7	2	22.2
Total.....	1,121	82.5	44.2	176	81.1	7	77.7
Mucoid enteritis, alone.....	106	7.8	44.7	26	12.0	0	0
Mucoid enteritis and pneumonia....	45	3.3	47.3	10	4.6	2	22.2
Total.....	151	11.1	45.3	36	16.6	2	22.2
Hemorrhagic enteritis, alone.....	86	6.3	40.8	5	2.3	0	0
Hemorrhagic enteritis and pneumonia....	1	.1	43.0	0	0	0	0
Total.....	87	6.4	40.8	5	2.3	0	0
All types enteritis, alone.....	1,063	78.2	43.5	160	73.7	5	55.5
All types enteritis and pneumonia....	296	21.8	46.3	57	26.3	4	44.4
Total ²	1,359	100.0	44.1	217	100.0	9	100.0

¹ Average age.² 14 of the total 1,599 animals were not recorded as they could not be classified.

ent in more than two-thirds of the cases. However, the weekly death rate of the developing stock was much lower than that of the younger animals, so that the economic loss from pneumonia in the former group was not a hardship. Among mature animals pneumonia was present in more than 75 percent of those dying, and 70 percent of those had no distinguishable disorder that could be considered as predisposing. Thus 53 percent of all losses among mature animals resulted from pneumonia alone. Among the breeding animals losses of does were three times as frequent as those of bucks, and their age at death was lower on the average.

As table 1 shows, abscesses about the face and jaws, together with long incisor teeth, were common factors predisposing to pneumonia in unweaned animals. The highest death rates from pneumonia alone were during the third week, as the young were emerging from the nest box, and during the eleventh week.

NEST-BOX MORTALITY

During the first 3 weeks of life mortality was very high, 1,160 animals having been lost. Of these, 1,017 died from causes more or less peculiar to animals of this age or under circumstances that made autopsy meaningless. Many of the young for which the cause of death was starvation may not have been strong enough to nurse prop-

erly under competitive conditions. Most does have eight nipples, and some have more, but young rabbits change nipples with great frequency, and the stronger ones often crowd others away. Many infants starved because the mothers were combating pneumonia or other diseases and provided little milk. However, starvation was often the result of disturbances of the does by night marauders, chiefly cats and opossums, the mothers being reluctant to remain in the nest boxes when prowlers were in the vicinity.

Almost 400 infants were so decomposed that autopsy was impractical. Heat prostration and trampling by frightened does were regarded as likely causes of death in a high proportion of the cases. Often the pattern of decomposition suggested the site of origin might have been the navel.

The 373 animals 3 weeks of age or less that died of miscellaneous causes included obvious cases of heat prostration, nest-box injuries, exposure as a result of falling from nest boxes in cold weather, and a large number of less frequent difficulties. Most nest-box injuries were inflicted by the stamping of frightened does. Thus, throughout, losses among animals of nest-box age have been largely attributable to inadequate protection from disturbances.

COCCIDIOSIS

Of the 1,962 animals more than 3 weeks of age examined for evidence of coccidiosis, in only 97, or 5 percent, was the disease present. According to species of the causative parasite, the cases were distributed as follows: *Eimeria magna*, 52; *E. media*, 39; *E. perforans*, 12; and *E. stiedae*, 1. *E. irresidua* was not present. Seven animals harbored two species of parasites. Over half of the infections showed oocysts in light concentrations or as mere traces. The heaviest concentration was found in an animal from the meat pen, dying with pneumonia. In this animal *E. media* alone was present, and no effects of the parasite were evident macroscopically in the intestine.

The incidence of the disease varied from month to month and from year to year. In May 1949 the incidence was highest—14.9 percent—and in three other months it was between 10 and 11.5 percent. In 7 months no cases were found. The yearly incidence of coccidiosis in animals autopsied was 5.7 percent for 1947, 2.9 percent for 1948, and 6 percent for 1949. When the incidence for corresponding months of all 3 years was averaged, September had the highest—7.6 percent—and December the lowest—2.4 percent. July and August both averaged less than 3 percent; May was second only to September, with 6.4 percent.

The youngest animal found to harbor coccidia died at 31 days of age. The remaining four coccidia-affected animals 5 weeks old or less died at 33, 34, 35, and 35 days, respectively. The approximate incidence of coccidiosis among animals dying at different ages is shown in figure 2. The incidence rose sharply between the eighth and ninth weeks and then dropped to zero by the end of the sixteenth week.

Among the animals dying of the major disorders or combinations of disorders, the numbers showing evidence of coccidiosis as compared

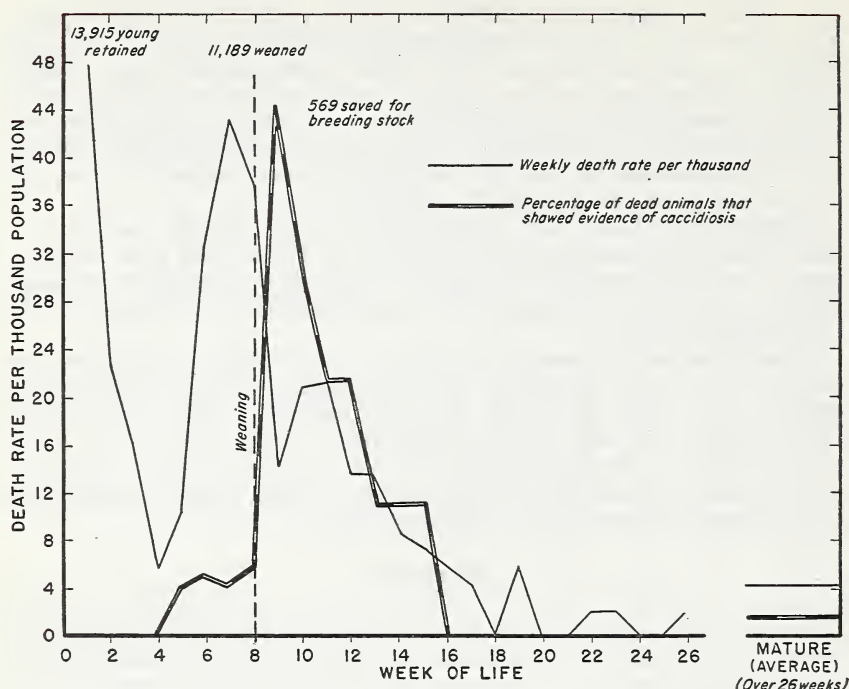


FIGURE 2.—Incidence of coccidiosis in animals dying at the United States Rabbit Experiment Station from 1947 to 1949, inclusive.

with the total number of deaths from each cause are shown in table 3. In all age groups the presence of coccidia had virtually no influence on the distribution of deaths. The percentage of unweaned animals dying with enteritis was the same for animals harboring the parasite as for the group as a whole, and, consequently, the same as for the 95 percent that did not have the parasite.

The most significant difference between the percentage of animals dying from the various causes and the percentage dead with coccidia occurred among the developing animals—in those dying from enteritis. It is surprising that the difference was not greater than 6 percent, because most cases of coccidiosis in recently weaned young are acquired as a result of the handling necessary in sexing, weighing, and isolating the young at this time (6). A period of 5 to 9 days must elapse before oocysts are in evidence. Most animals in this group were either used for experiments or sold for slaughter by the fourth day after weaning. Individuals showing evidence of the approach of enteritis were rejected in both instances and thus remained in the holding pens until the outcome had become apparent. During this time the prepatent stage of coccidiosis was often past, and if the animal died it was found to contain oocysts. Thus the group with coccidia was to some extent selective. On the whole, the data indicate that the coccidiosis cases encountered in this study had no demonstrable influence on mortality.

TABLE 3.—*Distribution of dead animals with evidence of coccidiosis compared with distribution of total dead*

Cause of death	Unweaned rabbits (29–56 days old)				Developing rabbits (57–180 days old)				Mature rabbits				Total			
	Total dead		Dead animals with coccidia		Total dead		Dead animals with coccidia		Total dead		Dead animals with coccidia		Total dead		Dead animals with coccidia	
	Num-ber	Per-cent	Num-ber	Per-cent	Num-ber	Per-cent	Num-ber	Per-cent	Num-ber	Per-cent	Num-ber	Per-cent	Num-ber	Per-cent	Num-ber	Per-cent
Cases studied.....	1,491	100.0	71	100.0	316	100.0	23	100.0	168	100.0	3	100.0	1,975	100.0	97	100.0
Enteritis.....	1,302	87.3	62	87.2	228	72.2	18	78.3	11	6.6	0	0	1,541	78.0	80	82.5
Pneumonia.....	390	26.2	20	28.2	104	32.9	7	30.4	127	75.6	2	66.7	621	31.4	28	28.9
Impaction.....	203	13.6	9	12.7	31	9.8	3	13.0	8	4.8	0	0	242	12.3	12	12.4
Enteritis without pneumonia or im- paction.....	884	59.3	40	56.4	146	46.2	11	47.8	7	4.2	0	0	1,037	52.5	51	52.6
Pneumonia without enteritis or im- paction.....	96	6.4	3	4.2	40	12.7	3	13.0	116	69.0	2	66.7	252	12.8	8	8.3
Enteritis with pneumonia.....	283	18.9	15	21.1	61	19.3	4	17.4	4	2.4	0	0	348	17.6	19	19.6
Enteritis with impaction.....	182	12.2	7	9.9	27	8.5	3	13.0	1	.6	0	0	210	10.6	10	10.3
Pneumonia with impaction.....	58	3.9	3	4.2	9	2.8	0	0	8	4.8	0	0	75	3.7	3	3.1

COMPARISON WITH STUDIES IN OTHER RABBITRIES

Throughout the study and in the years of exploratory work that culminated in the system used in the study, it was necessary to consider constantly how representative the mortality at the station was of that in the field. Two principal methods were employed in determining the extent of mortality in commercial rabbitries: The first was to arrange for close cooperation with a few operators whose records were so complete that total mortality could be determined with a high degree of accuracy. However, it was still necessary to examine the dead animals to determine the cause of death, and this soon became a limiting factor.

Only one large rabbitry was studied long enough to yield worthwhile results. This rabbitry maintained about 200 mature animals. Mortality in the unweaned young averaged 24 percent for a year, but fluctuated from 22 to 28 percent bimonthly. No record was kept on mortality in developing stock, but that in mature stock ranged from 18 to 20 percent. Annual replacement was about 70 percent, the average producing life of does being 18 months and that of bucks 2 months. Rigid culling was practiced. During a 6-week period in August and September 1946, losses were very heavy among animals 6 to 8 weeks old, and total mortality approached 30 percent for a brief interval.

Throughout most of this time the author examined all dead animals more than 6 weeks old. Almost all had diarrheal enteritis, but pneumonia was also present in more than 50 percent of the cases. This extremely high incidence of pneumonia with enteritis had not been noted earlier in the year when total enteritis losses were lighter. Collections of dead were made but once a day, which was too infrequent for accurate diagnosis. A curve of weekly death rates, plotted by the operator of this rabbitry, was almost identical in contour with that of figure 1, but the number of deaths was somewhat higher. It was highest in the first week of life and lowest in the fourth week. However, there is now evidence that some rabbitries experience their heaviest losses with enteritis at a somewhat earlier age than others do. More study is needed on this problem.

The second method of determining the extent of mortality was to obtain estimates of losses from a large number of breeders. In doing this, the same person questioned all growers, and the rabbitries were visited on a number of occasions distributed over a period of several weeks. Most of the breeders kept hatch-card records and some recorded losses individually, but some had to rely entirely on memory. The 48 breeders who gave estimates on this study had a total of 3,789 producing does, the smallest rabbitry having 14 and the largest having 240. The breeders' estimates of losses of unweaned young averaged only slightly more than two young per doe per year, which would have represented a mortality rate of between 8 and 9 percent. It seems likely that nest-box mortality was usually ignored. No attempt was made to establish an estimate of mortality among developing stock. Losses of mature animals were usually either recorded or remembered moderately well. The average annual loss of 19.9 percent reported by the 48 breeders was probably a little low.

The reported average annual cull was about 35 percent. This seems

low, but it was possible because at this time there was a favorable margin between feed costs and live-weight prices and growers appeared to be retaining many poor producers. In general, rabbitries with high standards of production cull heavily. Estimates on causes of losses yielded complex data, but "scours and bloat" (enteritis, especially the diarrheal type) was usually placed first. Pneumonia and three evidences of disturbances (sore hocks, caked breasts, and nest-box injuries) were all mentioned frequently as prevalent disorders.

Each rabbitry in the field had certain factors peculiar to it that tended to influence mortality. Among them were the presence or exclusion of predators, climatic differences, type of equipment, and variations in management. Some breeders were consistently able to restrict their mortality to about two-thirds that of the station herd, but many did well to avoid losses averaging $11\frac{1}{2}$ times those at the station. For the most part, the breeders who kept accurate records and strove to determine the nature of and to overcome their difficulties obtained results similar to those of the station herd.

SUMMARY AND CONCLUSIONS

To provide a tentative standard for rabbit raisers and investigators in comparing their death losses, this circular reports the mortality in the herd maintained at the United States Rabbit Experiment Station, Fontana, Calif., from 1947 to 1949, inclusive. Commercial rabbitries in the vicinity of the station were also studied from time to time to determine to what extent losses in the station herd were comparable with those in other herds. The following results were obtained.

Total mortality among animals of most ages varied considerably. Losses averaged 19.6 percent among the 13,915 unweaned young in the station herd. These were slightly lower than the average losses reported by commercial rabbitries participating in cost-account studies, but were higher than the average of breeders' estimates of their losses.

Only 9.5 percent of the 569 animals selected at 8 weeks of age for future breeding stock died before reaching the age of 6 months. On this basis, a breeder would need to save only 10 percent in excess of his annual replacement to assure the replenishment of his herd.

The average annual mortality among mature animals of the station herd was 24.8 percent, which appeared to be lower than the average in the field. However, it was higher than it should be under good commercial practice.

On a per capita basis, mortality is higher during the first week of life than at any other time. It is likely to be high during the first 3 weeks if night predators or other disturbing influences are present.

Enteritis, in one of its forms, is responsible for more mortality among unweaned young than any other disorder. Its incidence in any herd may vary a great deal at different times, but during the 3-year study 50 percent of the 2,726 unweaned animals lost in the station herd showed the disorder. It is seldom observed until after the fourth week of life. The exact age at which it is most prevalent as a factor in mortality appears to vary somewhat in different herds. At the station, greatest losses occurred during the seventh week.

Pneumonia is the greatest single cause of death in mature animals. It was present in 75 percent of the animals dying in the station herd from 1947 to 1949, inclusive. The major factors predisposing animals to pneumonia are as follows: In mature does, pregnancy, parturition, and heavy lactation; in 6- to 12-week-old animals, enteritis; and in nest-box babies, exposure and improper care.

Coccidiosis was not a factor in mortality in the station herd. Of the dead animals more than 3 weeks of age, only 5 percent showed evidence of the disease, whereas among living healthy animals the average incidence was about 7.5 percent. The highest mortality rate among animals more than 3 weeks of age was in the seventh week of life. The greatest incidence of coccidiosis was in the ninth week.

Mortality is much higher in breeding does than in bucks. However, the mortality of does not producing litters, such as Angora woolers, differs little from that of bucks.

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